2005-01-01

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Original Publication Citation

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Five Powerful Practices for Using Technology to Enhance Teaching and Learning in Higher Education

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Abstract: This presentation reports the findings from our investigation of the professors designated as the most innovative users of technology at our university. After seeking nominations from department heads, we selected thirty-five of the most successful and innovative professors as case studies. After interviewing these cases, and in some instances observing their classes, we identified five major patterns that represented the positive impacts technology was having on their instruction. These patterns were evident in several cases across many different disciplines, indicating they might be generalizable to many different situations and contexts. In our interviews, we identified what technologies these professors were using and how they were using them. In this presentation we will explain the five main practices for using technology to enhance instruction that we learned from these professors, as well as some ideas for how these practices can be more effectively applied in higher education.

Introduction

There has been much debate over the past decade regarding the value and impact of educational technologies in the teaching and learning process. There are many researchers who report technology as having a significant impact in classrooms (Brown, 2003; Dede, 2002, Roschelle et al., 2000). At the same time there are many who are skeptical of the benefits of technology relative to the costs (Zemsky & Massy, 2004). At the university level the cost of building a technology rich infrastructure can be as high as 10 percent of a large institution’s budget (Gueldenzoph et al., 1999).

How can some educators and researchers find useful effects from using educational technologies while others do not? We theorized that these disparate views could be due to differences in what technologies were used, what contexts they were used in, and how they were implemented by the professors. In this study we sought to learn from the best practices of faculty across all major disciplines on campus. In this paper we outline what we learned from the study. More details can be found in another article by the authors (West & Graham, in press).

Methods

In this study we wanted to better understand whether there might be some practices, common among successful users of technology, that could be applied in different contexts. We investigated professors that were recommended by department heads, other faculty, and BYU’s Center for Instructional Design as being “innovative” examples of how technology can be used effectively in teaching. After receiving 135 recommendations, we selected thirty-five cases that seemed especially successful or innovative. These cases represented twenty-four departments and eleven of the thirteen colleges at our institution. In our interviews with these professors, we asked for detailed descriptions what technologies they used and how and why they used them. Using a constant comparison approach, we discussed the interviews as a research team, looking for patterns that were generalizable across departments and colleges. Through these discussions we identified five powerful ways faculty used technology that were grounded in our case studies. We will describe these ideas and give a few brief examples from our case studies, and we will then suggest ideas for implementing these principles in higher education classes.
Five Practices

The five powerful ways to use technology in teaching we identified are:

1. Technology can help learners to visualize content
2. Technology can facilitate learner/instructor and learner/learner interactions
3. Technology can support meaningful learner reflection
4. Technology can involve learners in authentic, real-life learning activities
5. Technology can improve the quality and quantity of learner practice

Practice 1 — Technology can help learners to visualize content

Description: We found that technology can increase learning by helping abstract principles become concrete mental images more easily remembered and understood by students.

Case Studies: One professor that we interviewed used software programs such as Geometer Sketchpad and Fathom, programs that dynamically show geometric or statistical principles in action. Another teacher, after struggling for years to help students grasp how economic rates and behaviors were interrelated, created several simple Macromedia Flash animations that dynamically represented these changes, and the students are finally understanding these relationships. In a music conducting course (see Figure 1), students sometimes struggled to grasp how they were failing because they couldn’t see the master conductor’s hands from the correct point of view for proper imitation, but the use of video allows them to “look over the shoulder” of the conductor and watch how he guides the music. A French literature professor trying to help students understand the irony in a famous French novel created a simulation that visually represented the verbal ironies in the text.

![Figure 1: Technology allows learners to see a conductor’s hands from the vantage point of a conductor as well as the audience.](image)

Practice 2 — Technology can facilitate learner/teacher and learner/learner interactions

Description: In our study, we found that technology was being used by faculty to enable more frequent as well as more individualized interactions between students and faculty.

Case Studies: A theater professor requires her students to discuss their reflections through Blackboard discussion boards. So far, she has been thrilled with how more of the “quiet” students in her classes are “talking” to each other and how critically reflective discussions have been. Another professor teaching a large Physics 100 course used audience-response technology to quickly assess how well his students, collectively and individually, understood the material (see Figure 2). This allowed him to tailor his instruction to the needs of specific classes and/or individuals. Another professor used ClipMate to quickly provide detailed feedback to students.
Figure 2: In class, students respond to quiz questions and the class statistics are immediately depicted on the screen (as shown above) allowing the instructor to provide immediate feedback addressing class misconceptions.

Practice 3 — Technology can support meaningful learner reflection

Description: Some educational researchers are investigating ways that technology may mediate student reflection (Boer and Collis, 2002). One department at our university is exploring the use of a video-analysis tool to support student reflection.

Case Studies: Our university’s physical education department is using StudioCode, a tool that allows student teachers to record themselves and code segments of their video as a reflective process (see Figure 3). Because the tool employs video, students don’t need to rely on their memory but can view the same experience many times, looking for different criteria each time. Already other professors are interested in using a similar tool to help students self-assess their performance law negotiation, student teaching, music performance, and dance.

Figure 3: Students teachers in physical education can analyze and reflect on their teaching performance by using video coding software.
**Practice 4 — Technology can involve students in authentic, real-life learning activities**

*Description:* Several studies have found evidence that technology can effectively enable authentic, or situated, learning (Roschelle, Pea et al., 2000; King, 2003). We found many cases where the primary purpose for using the technology was to enable a more authentic experience.

*Case Studies:* In one course, an introduction to media writing, a professor is attempting to recreate a controversial city council meeting by linking videos and official documents in a website for student reporters to view and download. A business professor used Internet market research so that hundreds of responses to a survey could be collected in days. Students can now participate in more learning activities because the mundane task of collecting survey responses is automated. In a different scenario, a psychiatric nursing professor required her students to listen to recordings of screaming voices while they completed a test so they could “experience” schizophrenia to a small degree. One professor helped design The Virtual ChemLab so students could do “real” chemistry and explore different experiments in a simulated laboratory (see Figure 4).

![Figure 4: Life-like chemistry simulations like Virtual ChemLab help students to explore real chemistry problems that wouldn’t be available to them in the lab because of cost or danger.](image)

**Practice 5 — Technology can improve the quality and quantity of students’ practice**

*Description:* We found that many technologies either enabled students to 1) practice a skill *more frequently*, or 2) practice *more effectively*.

*Case Study:* A construction management professor described how electronic blueprints were much more accessible than regular blueprints and how estimating software automated the routine, lower-level tasks so students could perform many more estimations in a semester. In another case, a math education professor used an interactive whiteboard and TechSmith’s Camtasia Studio to record himself working through math problems on the whiteboard. The professor then posted these video clips on his website so students, after attempting to solve the problems, could download the clips and watch how the professor solved the problems. Figure 5 shows an example of the Virtual Audiometer that allows students to practice diagnosing virtual patients. This simulation tool allows students to increase the quantity of their practice by giving them access to equipment and a wide range of virtual patients. The quality of student practice with real equipment and limited real patients can also be improved because of early practice with the Virtual Audiometer.
Figure 5: The Virtual Audimeter allows students to practice using sophisticated equipment to diagnose patients with hearing problems.

Conclusion

We believe that technology can make a difference in teaching and learning. As we looked at a wide variety of cases across the Brigham Young University campus we found ample evidence that innovative faculty were using technology in ways that did improve the learning experience for their students. The five practices for effective technology use presented in this paper are:

1. technology can help learners to visualize content,
2. technology can facilitate learner/instructor and learner/learner interactions,
3. technology can support meaningful learner reflection,
4. technology can involve learners in authentic, real-life learning activities, and
5. technology can improve the quality and quantity of learner practice.

These five practices were our attempt to distill the essence of how faculty in our case studies were using technology to effectively impact learning in their classrooms. Figure 6 outlines the five practices and provides some basic ideas and guidelines drawn from our cases for implementing each practice.
Figure 6: Some basic guidelines for implementing the five practices for using educational technologies outlined in this paper.

References


